Original Article

Evaluation of Operative Management of Displaced Acetabular Fractures by Single Non-Extensile Surgical Approach

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Received: 11-02-2024; **Revised:** 25-03-2024; **Accepted:** 03-04-2024; **Published on:** 15-04-2024.

ABSTRACT

Introduction: Fractures of the acetabulum and pelvis constitute only 2% of all fractures. but they are associated with significant morbidity and mortality due to associated injuries. In certain situations, single non-extensile surgical approaches cannot provide adequate visualisation and reduction of the fracture. To enhance visualization and anatomical stable reduction of fractures in such circumstances, a range of specific reduction tools, indirect reduction procedures, and additional surgical techniques can be employed.

Aims/ objective: To measure the radiological and functional outcome of operative management of displaced acetabular fractures by using a single non-extensile surgical approach.

Materials and Method: 21 cases of radiologically proven cases of displaced acetabular fracture were includedFor classification of fractures, Judet and Letournel's classification was used. Functional outcome was assessed at 6 months with the clinical grading criteria devised by Modified Merle d'Aubigne and Postel, having three parameters: pain, ambulation and range of motion and will be graded as: Excellent- score 18, Good- score 15-17, Fair- score 13-14 and Poor- score < 13.

Results: Out of 21 cases recruited in the study, 5 cases had excellent clinical outcome, 13 with good, 2 with fair and 1 with poor clinical outcomes. In our study 7 (33.33%) patients had fracture of the quadrilateral plate, among them 3 patients had transverse with posterior wall fracture. We used Ilioinguinal (anterior approach) 38.1% cases and Kocher-Langenbeck (posterior approach) in 13 (61.9%) cases. There was significant correlation between complications and clinical outcome ($p<0.05$). There was significant correlation between radiological grade and clinical outcome ($p<0.05$).

Conclusion: The single non-extensile surgical approaches supplemented by indirect reduction and fixation by lag screws can minimize the indications for extensile or combined surgical approaches for the management of displaced acetabular fractures including complex fractures and can achieve satisfactory reduction as well as function by avoiding the complications of extensive surgeries.

Keywords: Acetabular Fracture, Non-Extensile Surgical Approach, Clinical Outcome, Radiological Grade.

INTRODUCTION

Fractures of the acetabulum and pelvis constitute only 2% of all fractures. [1,2] but they are associated with significant morbidity and mortality due to associated injuries. [3] Fractures of the acetabulum result from high energy accidents and occurs commonly in young active male people. Treatment of these injuries is quite difficult due to the three-dimensional structure of the bone and the anatomic position of the acetabulum. The severity of these injuries is demonstrated by the fact that early descriptions of acetabular fractures are the result of autopsy findings of patients who had sustained significant trauma.[4]

From a historical perspective, the early literatures offered conflicting recommendations regarding the optimal care for a fracture of acetabulum.[5,6] Both non-operative and operative treatment regimens were purported to be the best. However, much of the confusion in management recommendations can be attributed to the fact that there was no comprehensive or accepted acetabular fracture classification, an unsatisfactory situation that was well recognized even at that time.[7]

Studies have shown that to attain the best results, hip joint congruity and stability must be accompanied by an anatomic (defined as less than 2 mm of residual displacement) reduction of the displaced articular surface.[8,9] Thus, precise reduction of the intra-articular fracture fragments and maintenance of this reduction with internal fixation are essential for a favourable result. It has been stressed that in a displaced fracture this anatomic reduction is difficult, if not impossible, to obtain by closed means. [10,11]

In addition, standard plate and screw fixation constructs, which require open surgery, have been shown to be stronger than their percutaneous counterparts, demonstrating greater yield strength and maximal load at failure. [12] Therefore, open anatomic reduction and internal fixation continue to serve as the mainstay in treatment of displaced fractures of the acetabulum.

For simple displaced acetabular fractures, single non-extensile surgical approaches i.e. Kocher-Langenbeck, Ilioinguinal and Iliofemoral are recommended.[8] In cases when two columns are affected or the degree of joint incongruence is significant as in complex acetabular

fractures, a different surgical tactic could be considered: combined anterior and posterior approach or extensile approaches, such as the extended iliofemoral (EIF), triradiate approach of Mears & Rubash or the T- approach of Reinert. [13]

The surgical approach for these fracture types are not consistent and should be chosen according to the specific fracture pattern and surgeon experience. [9,14] The extensile surgical approaches can really achieve a wide exposure of the acetabulum and both columns. However, such approaches result in an increased number of complications: increased blood loss, extended surgical time, heterotopic ossifications, infection, abductor weakness, deep haematoma, delayed union, avascular necrosis of bony fragments, and posterior gluteal muscle necrosis. [15,16]

Combined approaches are associated with prolonged surgical time, increased risk of infection, increased blood loss, difficulty in patient positioning and extreme surgeons' exhaustion. In the triradiate approach, the sciatic nerve is in jeopardy and at increased risk of injury. Also there is increased risk of injury to the superior gluteal vessels and nerve. It is seen that the non-extensile single surgical approaches in two-column and complex type of acetabular fractures give adequate exposure of the fracture fragments and anatomic reduction and stable fixation.

In certain situations, single non-extensile surgical approaches cannot provide adequate visualisation and reduction of the fracture. To enhance visualization and anatomical stable reduction of fractures in such circumstances, a range of specific reduction tools, indirect reduction procedures, and additional surgical techniques can be employed. [17, 18]

So, we tried to conduct a prospective study to measure the radiological and functional outcome of operative management of displaced acetabular fractures by using a single non-extensile surgical approach.

MATERIALS AND METHODS

In this prospective interventional case study patients with acetabular fractures reporting to the orthopaedics department of Deen Dayal Upadhyay Hospital, Hari Nagar, New Delhi were admitted and subjected to detailed history and examination and also were subjected to standard x-ray and CT imaging. Radiologically proven cases of displaced acetabular fracture were included from March 2016 to January 2017 and subjected to open reduction and internal fixation by using standard single non-extensile surgical approaches. A total of 21 cases were included in the study. These cases were studied prospectively and the minimum period of follow up was 6 months. We tried to determine the clinical and radiological outcome of these procedures in terms of standard clinical and radiological grading systems.

Inclusion Criteria:

- All displaced fractures of acetabulum involving superior weight bearing dome leading to hip instability and or joint incongruity.
- All above mentioned fractures within three weeks of injury.
- Medically fit patients.

Exclusion Criteria:

- Undisplaced & minimally displaced acetabular fractures, fractures involving nonweight bearing dome of acetabulum which are not affecting stability of the hip joint like small posterior wall, low infra-tectal transverse, low anterior column fractures.
- Patient presenting after three weeks of injury.
- Patient with severe systemic illness.

Initially the patients were managed according to the ATLS protocol in the emergency department and once the vitals of the patient were stabilized, thorough history taking and examination was done. [19] A thorough radiological evaluation was done using preoperative radiographs of the patients and Computerized Tomography scan with 2D reconstruction. The status of acetabulum was evaluated roentgenographically on anteroposterior view, obturator oblique view and iliac oblique view.

Factors like fracture displacement, comminution, associated chondral damage to the femoral head and acetabulum, marginal impaction, intra articular fragments and femoral head lesions were assessed radiologically. For classification of fractures, Judet and Letournel's classification was used. [20]

Patients were operated by Kocher-Langenbeck, Ilioinguinal or Iliofemoral approach according to the fracture types. [21] In any of these approaches, the following intra-operative findings were noted: 1) Intra-operative blood loss, 2) duration of surgery, 3) Any vascular injury, 4) marginal impaction of posterior wall, 5) associated chondral damage to femoral head, 6) comminution, and 7) intra articular fragments.

Radiological outcome was assessed by the Modified Radiological Reduction Criteria of Matta et al. [9,10] using immediate postoperative plain radiographs of three standard views i.e. anteroposterior view, obturator oblique view and iliac oblique view. The outcome were termed as: Anatomical- 0 to 1 mm of displacement, Imperfect- 2 to 3 mm of displacement and Poor- >3 mm of displacement. Functional outcome was assessed at 6 months with the clinical grading criteria devised by Modified Merle d'Aubigne and Postel, [22] having three parameters: pain, ambulation and range of motion and will be graded as: Excellent- score 18, Good- score 15-17, Fair- score 13-14 and Poor- score < 13.

Statistical Analysis: The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0. Categorical variables were correlated using Chi-Square test /Fisher's exact test. A p value of <0.05 was considered statistically significant.

OBSERVATIONS AND RESULTS

Out of 21 cases recruited in the study, 5 cases had excellent clinical outcome, 13 with good, 2 with fair and 1 with poor clinical outcomes.

In our study (table 1), the majority of patients were in the age group of 20 to 40 years, with the mean age being 33.71 years. In our study, there were 16 (76.19) % males and male to female ratio was 3.2:1. In our study, 17 (80.95%) patients sustained fractures because of road traffic accidents which also included pedestrian struck injuries. Only 4 (19.05%) patients sustained fractures due to fall from height. 6 (28.57%) patients had associated posterior hip dislocation and 1 (4.76%) had anterior hip dislocation. There was significant correlation between presence of associated injury and clinical outcome (p<0.05).

In our study (table 2) 7 (33.33%) patients had fracture of the quadrilateral plate, among them 3 patients had transverse with posterior wall fracture, 1 had transverse fracture, 1 had anterior column fracture, 1 had anterior column with posterior hemi-transverse fracture and 1 had T-type fracture. 1 patient having anterior column and 1 patient having anterior column with posterior hemi-transverse fracture had comminution of fracture fragments. 1 patient having anterior column fracture had ipsilateral femoral head lesion in the form of infra-foveal un-displaced femoral head fracture which was managed conservatively.

Table 1: Correlation of baseline demographic and clinical variables with respect to study outcome

Parameter	Category		Clinical Outcome				
		Excellent	Good	Fair	Poor	Total	P-Value
Age	≤ 30 Years	3 (27.27)	6 (54.55)	1 (9.09)	1 (9.09)	11	0.745
	> 30 Years	2 (20.00)	7 (70.00)	1 (10.00)	0 (0.00)	10	
Sex	Female	0 (0.00)	4 (80.00)	0 (0.00)	1 (20.00)	5	0.125
	Male	5 (31.25)	9 (56.25)	2 (12.50)	0 (0.00)	16	
Mode of Injury	R. T. A	5 (29.41)	9 (52.94)	2 (11.76)	1 (5.88)	17	0.385
	Fall from height	0 (0.00)	4 (100.00)	0 (0.00)	0 (0.00)	4	
Associated Injury	Yes	0 (0.00)	9 (81.82)	1 (9.09)	1 (9.09)	11	**0.048**
	No	5 (50.00)	4 (40.00)	1 (10.00)	0 (0.00)	10	
Hip Dislocation	Yes	2 (28.57)	4 (57.14)	1 (14.29)	0 (0.00)	7	0.828
	No	3 (21.43)	9 (64.29)	1 (7.14)	1 (7.14)	14	

Table 2: Correlation between X-Ray and CT findings and Clinical Outcome

X-Ray and CT Findings		Excellent	Good	Fair	Poor	Total	P-Value
Quadrilateral Plate	Frequency	0	5	1	1	7	0.179
	%	0.00%	71.43%	14.29%	14.29%		
# Communition	Frequency	0	1	1	0	2	0.214
	%	0.00%	50%	50%	0.00%		
Marginal Impaction	Frequency	0	0	0	0	0	
	%	0.00%	0.00%	0.00%	0.00%		
Intra articular Fragment	Frequency	0	0	0	0	0	
	%	0.00%	0.00%	0.00%	0.00%		
Head Lesion	Frequency	0	1	0	0	1	0.886
	%	0.00%	100%	0.00%	0.00%		

Table 3: Correlation of surgical factors with respect to study outcome

Parameter	Category		Clinical Outcome				
		Excellent	Good	Fair	Poor	Total	P-Value
Surgical Approach	Anterior	1 (12.50)	5 (62.50)	1 (12.50)	1 (12.50)	8	0.486
	Posterior	4 (30.77)	8 (61.54)	1 (7.69)	0 (0.00)	13	
Duration of Surgery	2- 3 hours	4 (33.33)	7 (58.33)	1 (8.34)	0 (0.00)	12	0.381
	≥ 3 hours	1 (11.11)	6 (66.67)	1 (11.11)	1 (11.11)	9	

We used two surgical approaches in our study. Ilioinguinal (anterior approach) was used in 8 (38.1%) cases and Kocher-Langenbeck (posterior approach) in 13 (61.9%) cases. Operative time ranged from 2 hours to 4 hours with an average of 2.62 hours.

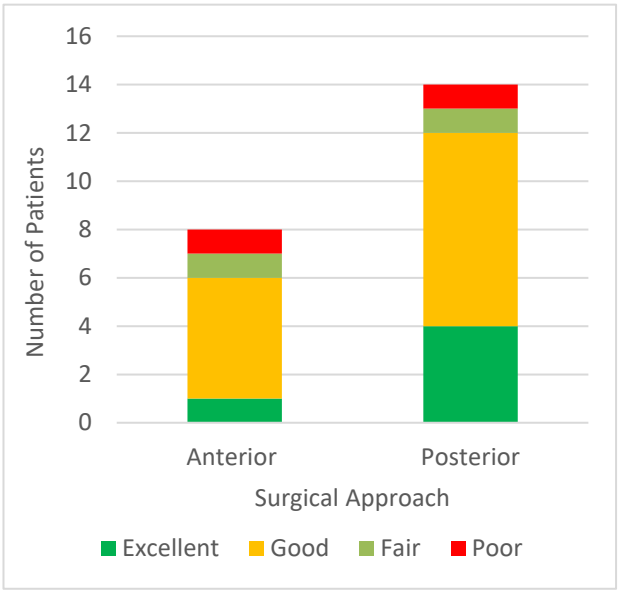

Figure 1: Correlation of Surgical Approach with Clinical Outcome

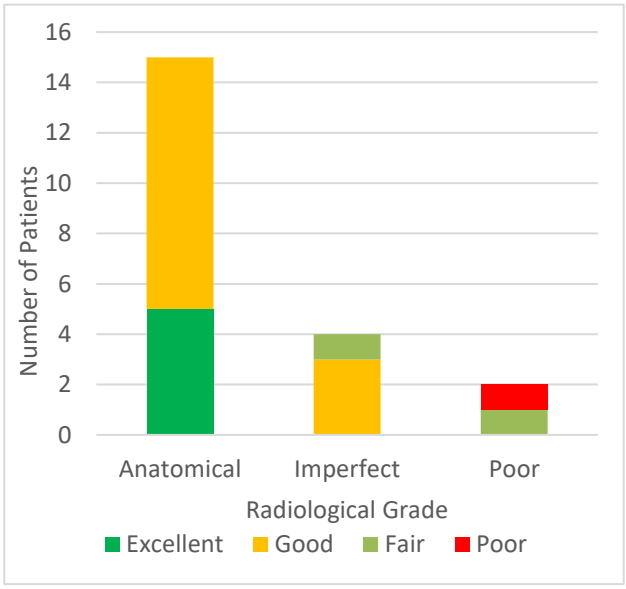

Figure 2: Correlation of Radiological Grade with Clinical Outcome

Table 4: Correlation between complications and clinical outcome

Complications		Excellent	Good	Fair	Poor	Total	P value
Absent	Frequency	4	9	1	0	14	0.0475
	%	28.57%	64.29%	7.14%	0.00%		
Hardware complication	Frequency	0	0	0	0	0	
	%	0.00%	0.00%	0.00%	0.00%		
INI	Frequency	1	3	1	0	5	
	%	20.00%	60%	20%	0.00%		
Loss of reduction	Frequency	0	0	0	1	1	
	%	0.00%	0.00%	0.00%	100%		
Surgical site infection	Frequency	0	1	0	1	2	
	%	0.00%	50%	0.00%	50%		

There were 2 case (9.52%) of superficial surgical site infection of which 1 patient was diabetic for which blood sugar was controlled by starting her on insulin on sliding scale. Both the infections got subsided by 14th postoperative day after serial dressings of the wound. There was significant correlation between complications and clinical outcome ($p<0.05$).

Table 5: Clinical results compared with post-operative radiological results

Radiological Grade		Excellent	Good	Fair	Poor	Total	P value
Anatomical	Frequency	5	10	0	0	15	0.005
	%	33.33%	66.67%	0.00%	0.00%		
Imperfect	Frequency	0	3	1	0	4	
	%	0.00%	75.00%	25.00%	0.00%		
Poor	Frequency	0	0	1	1	2	
	%	0.00%	0.00%	50.00%	50.00%		

There was significant correlation between radiological grade and clinical outcome ($p<0.05$).

DISCUSSION

Fractures of the acetabulum remain a major challenge to the orthopaedic surgeon. The complex structure of the pelvis, the deeply situated acetabulum, complex fracture patterns and lack of proper understanding of the fracture pattern and expertise are the main reasons cited for the difficulties.

Open reduction and internal fixation for displaced acetabular fractures has become a standard treatment option during the past three decades. Numerous surgical approaches and techniques have described in the last few decades, each having their own advantages and disadvantages.

In our study, we tend to determine the clinical and radiological outcome in terms of standard grading systems in patients operated for displaced acetabular fractures using single non-extensile surgical approaches. Our study included 21 patients with displaced acetabular fractures who underwent operative reduction in our hospital.

Clinical grading was done according to the modified Merle d'Aubigne & Postel criteria given by Joel M. Matta in 19969.[9, 22] Degree of pain, degree of ambulation and range of motion at 6 months follow up were used for scoring. Each component was given points out of 6. All the points were totalled and the outcome was graded. Our series had 5 (23.81%) excellent results, 13 (61.90%) good results, 2 (9.52%) fair results, and 1 (4.76%) poor result. In our study there was a significant correlation between radiological grade and clinical outcome. Following are the results of other series like Brueton et al in 1993 who reported 19% excellent, 42.5% good,11.5% fair and 27% poor results. [23] In 1994, Mayo got 14% excellent, 61% good,16% fair, and 9% poor results. [24] Matta et al in 1996, were able to achieve 40% excellent, 36% good, 8% fair, and 16% poor results. In our series total of excellent and good results were 85.71%, which were comparable to the total of excellent and good results given by Giannoudis et al (79. 4%).[9, 25]

In our study, 17 (80.95%) patients sustained fractures because of road traffic accidents which also included pedestrian struck injuries. Only 4 (19.05%) patients sustained fractures due to fall from height. This figure compares favorably with data of other series like in Letournel study; majority of fractures were due to RTA. [8] Percentage of acetabular fractures caused by RTA reported by Mayo was 80%, in Matta study it was 83%, and in Giannoudis study 80% patients were injured due to RTA.[9, 24, 25]

We used two surgical approaches in our study. Ilioinguinal (anterior approach) was used in 8 (38.1%) cases and Kocher-Langenbeck (posterior approach) in 13 (61.9%) cases. The type of approach to be used was dictated by the fracture pattern. [9] Hence there is no point comparing the figures with other series. Giannoudis et al. meta-analysis (2005) used kocher-Langenbeck approach in 48.7% patients, data compared to our series. [25]

There were 2 case (9.52%) of superficial surgical site infection of which 1 patient was diabetic for which blood sugar was controlled by starting her on insulin on sliding scale. Both the infections got subsided by 14th postoperative day after serial dressings of the wound. Giannoudis et al. (2005) in his study of 3670 fractures reported 4.4% patients with local infection and this was also noted by N.Briffa et al(2011) in 5.6% of his patients. [25, 26] There was hypoesthesia in the distribution of lateral cutaneous nerve of the thigh in 5 (23.81%) patients managed by anterior (Ilioinguinal) approach. T.A. El khadrawe et al. (2011) also noted lateral cutaneous nerve palsy in 12.8% patients in his study. [27]

Reduction was assessed by the measurements made on anteroposterior and 45°oblique (Judet views) radiographs according to the criteria given by Matta et al. in 1996. [9] In our series, the reduction was anatomical (0-1mm) in 15 (71.43%) patients, Imperfect (1- 3mm) in 4 (19.05%) patients and poor (>3mm) in 2 (9.52%) patients. Our results are comparable with the study done by Matta et al 1996. [9] In his study, anatomical result was seen in 71%, imperfect in 22% and poor results in 7% patients. Poor results were seen in patients who had postoperative 4 mm articular step among which 1 patient had loss of reduction in subsequent follow up. In our series there was a significant correlation between the radiological grade and the clinical outcome (p value 0.005).

CONCLUSION

Operative management of displaced acetabular fractures using single non-extensile surgical approach was able to achieve anatomical reduction in most of the patients and most of these patients had good to excellent clinical outcome based on Modified Merle d'Aubigne & Postel Clinical Grading System. Single non-extensile surgical approaches were found be less extensive and of shorter duration, so post-operative morbidities were much less compared to the extensile or combined approaches. Also, the intraoperative blood loss was quite less. Also, the long term complications such as heterotopic ossification, delayed union and avascular necrosis of bone fragments were found to be very minimal in this approach.

So, the single non-extensile surgical approaches supplemented by indirect reduction and fixation by lag screws can minimize the indications for extensile or combined surgical approaches for the management of displaced acetabular fractures including complex fractures and can achieve satisfactory reduction as well as function by avoiding the complications of extensive surgeries.

Source of Support: The author(s) received no financial support for the research, authorship, and/or publication of this article

Conflict of Interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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